MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 3, 2017/2018

EEE7216 – ENGINEERING OPTIMIZATION

6 JUNE 2018

10:00 A.M. – 1:00 P.M.

(3 Hours)

INSTRUCTIONS TO STUDENTS:

1. This question paper consists of 7 pages only (including this page).

2. Attempt ALL **FOUR** questions. All questions carry equal marks (25 marks) and the distribution of the marks for each question is given.

3. Please print all your answers in the Answer Booklet provided. Please submit the softcopy of the report generated by Excel Solver as well.

Question 1

(a) Consider the following linear programming (LP) problem:

$$\begin{aligned} &\text{Maximize } z = 6x + 2y \\ &\text{subject to:} \\ &\quad x + y \leq 5 \\ &\quad 3x + y \leq 11 \\ &\quad y \leq 5 \\ &\quad x, y \geq 0. \end{aligned}$$

(i) Given that the above LP problem has alternative optimal solutions, use Excel Solver to obtain the optimal solution and the optimal value. In your work, show clearly the additional constraints imposed to the original LP problem in order to obtain both optimal basic feasible solutions. Hence, or otherwise, write the corresponding parametric equation for all the optimal non-basic feasible solutions.

[8 marks]

(ii) Give a two-dimensional graphical demonstration of the feasible region. Indicate the possible path followed by each iteration of simplex method in solving the problem.

[4 marks]

(b) Alpha Engineering Sdn. Bhd. manufactures four types of electronics components, namely E.I, E.II, E.III and E.IV. The production process requires three types of resources: resistor, capacitor and chips. The following table summarizes the availability of the resources and their usage in production, as well as the prices per unit of electronics components (in RM100).

	Resource requirement per unit				
Resource	E.I	E.II	E.III	E.IV	**Daily availability**
Resistor	3	4	2	3	1300
Capacitor	3	2	4	5	1000
Chips	1	3	2	2	900
Price (In RM100)	4	6	5	4	

(i) Formulate a linear programming problem to determine the daily production figure. Use Excel Solver to solve the problem.

[7 marks]

Continued...

(ii) If additional units of chips can be acquired at RM0.50 per unit, is this advisable to increase the chips daily availability? Explain. [2 marks]

(iii) A suggestion is made to increase the number of resistor by 10% to remove the bottleneck in production. Is this advisable? Justify your answer. Give the impact to the total profit if your answer is yes. [2 marks]

(iv) Currently, the optimal solutions suggest that electronic component E.IV is not produced. By how much should its profit be increased to be able to be included in the production schedule? [2 marks]

Continued...

Question 2

Three factories are engaged in the production of a semiconductor device. The devices have to be transported by trucks from the factories to four clients. The total number of the transported devices depends on the capacities of the routes, which are limited by the number of trucks available and the number of trips made daily. Some of the factories cannot ship directly to some clients. The following table provides the daily capacities of the devices transported by the associated routes.

		Client			
		1	2	3	4
Factory	1	40	10	0	50
	2	0	0	20	100
	3	100	30	40	60

Given that the daily production figure from factory 1, factory 2 and factory 3 is 100, 200 and 150, respectively. Determine the truck trips schedule such that most device can be transported from the factories to the clients.

(a) Represent the above problem in network form. [4 marks]

(b) Formulate a linear programming problem to determine the truck trips required such that most devices can be transported from the factories to the clients. [4 marks]

(c) Solve the linear programming problem using Excel Solver. [7 marks]

(d) If the minimal demand from client 1, client 2, client 3 and client 4 is 120, 40, 20 and 190, respectively, will the proposed solutions from part (c) satisfy all the demand? If not, how do you modify the linear programming to accommodate the minimal demand requirement? Give the new solution that can accommodate the minimal demand from the clients. [5 marks]

(e) Refer to the original problem. Suppose trans shipping is allowed between factory 2 and factory 3. The maximum two-way daily capacity on the proposed transshipping routes is 50. What is the effect of trans shipping on the solutions? [5 marks]

Continued...

Question 3

(a) As a production engineer, you are assigned the task to determine the sites to construct various production lines for a new product. You have to choose 3 sites out of 7 sites. The following table provides the information about the exploration costs associated with each site.

Site	Cost (RM)
1	110,000
2	150,000
3	100,000
4	160,000
5	130,000
6	140,000
7	180,000

The company development policy provides the following conditions:

(i) Of the group Site 1, Site 2, Site 3 and Site 4, only two sites can be explored.

(ii) Exploring Site 1, Site 2 **and** Site 7 will prevent you from assessing Site 6;

(iii) Exploring Site 3 **or** Site 5, will prevent you from assessing Site 7.

There are two groups of technicians available to serve the new production lines. However, the company policy only allows you to choose one group out of these two groups. The following table gives the number of technicians required at each site, and the total technician available for each group.

Site	Group 1 Technician	Group 2 Technician
1	10	8
2	15	12
3	20	25
4	16	18
5	17	20
6	19	15
7	26	20
Number of technician available	70	60

Formulate an integer program to minimize the total exploration cost (DO NOT solve the problem).

[10 marks]

Continued...

(a) Consider the following mixed integer programming problem:

$$\text{Maximize } z = 18x_1 + 30x_2 + 20x_3 + 17x_4$$
$$\text{subject to :}$$
$$2x_1 + 4x_2 + 3x_3 + 2x_4 \leq 40$$
$$2x_1 + 2x_2 + 2x_3 + 3x_4 \leq 42$$
$$3x_1 + 2x_2 + 3x_3 + 2x_4 \leq 45$$
$$x_1, x_2 \text{ are integrals, } x_3, x_4 \geq 0.$$

Apply the branch-and-bound procedure to solve the above problem. Solve each relaxation of linear programming problem encountered by using Excel Solver. Interpret the branch-and-bound procedure using network.

[15 marks]

Continued...

Question 4

(a) Use the Golden section method with an error tolerance $\epsilon = 0.05$ and initial bound $x = 0$ and $x = 1$ to approximate the optimal solution of the following problem:

$$\text{Maximize } z = 4cos\theta(1 + sin\theta),\ 0 \leq x \leq 1$$

[10 marks]

(b) Consider the following problem:

$$\text{Minimize } z = 10x_1^2 - x_2^2 + x_1x_2$$
$$\text{subject to :}$$
$$\frac{x_1}{1 + x_2} \leq 1$$

Re-express the above nonlinear problem into its separable form (DO NOT solve the problem).

[5 marks]

(c) Consider the problem

$$\text{Maximize } z = 5x_1 + 10x_1^2 - 5x_2^2 + 5x_2$$
$$\text{subject to :}$$
$$x_1 + x_2 \leq 5,$$
$$x_1, x_2 \geq 0.$$

(i) Solve the above nonlinear problem with Excel Solver.
(ii) Give the complete model if the objective function is approximated by piecewise-linear curves with two segments on each curve. Solve the approximate problem using Excel Solver.
(iii) Compare the optimal solutions obtained by part (i) and part (ii).

[10 marks]

End of Paper.